DIFFERENTIAL REACTIONS OF INBRED LINES AND HYBRIDS OF CORN TO CERTAIN SEED DISINFECTANTS

BY

ROBERT PAUL PFEIFER

B.S., University of Illinois, 1942

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRONOMY
IN THE GRADUATE COLLEGE OF THE
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DIFFERENTIAL REACTIONS OF INBRED LINES AND HYBRIDS OF CORN TO CERTAIN SEED DISINFECTANTS

A considerable amount of research has been conducted to evaluate the effectiveness of seed treatment materials on seed corn. The results of this work have been inconsistent from place to place as well as from year to year. It was assumed that differential response of strains of corn to seed treatment was partly responsible for these inconsistencies. This investigation was undertaken to learn more about the differential response of inbreds and hybrids to seed treatment. With this information more definite recommendations may be made concerning seed treatment for corn, and a breeding program can be planned that may make possible a reduction in the amount of seed treatment required on corn.

Materials and Methods

Twenty-one inbred lines were reciprocally crossed on a single cross tester Hy2 x 38-11. Seed of these inbred lines and hybrids was tested for its differential response to seed treatment materials, Arasan, Spergon, and Semesan Jr. The following methods were used to determine these responses. (1) Germination and early vigor ratings were determined for the seed of 16 of the above inbred lines and 16 test hybrids and their reciprocals when grown in soil naturally infested with disease organisms under controlled low temperature. (2) The remnant seed (stored 2 months at 15% moisture) from the first method was planted in field trials and the response to seed treatment was measured by yield of shelled grain. (3) Seed of 5 of the above test hybrids and their reciprocals which was stored for 19 months at 15% moisture was also tested in a field trial. (4) On basis of cold test data, method (1), 6 inbred lines were chosen for crossing in all possible ways including reciprocals, and all 30 hybrids were tested in a field trial after they were treated with a modified slurry-seed-treatment process.

Experimental Results

Cold test data. Arasan, Spergon, and Semesan Jr. treatments increased germination of seed in the cold test. The average germination of the untreated seed was 24%. The germination of seed treated

with Arasan at the rate of 1 ounce per bushel was 81%; Spergon 69%; and Semesan Jr. 66%. The 2 ounce per bushel dosage of Arasan was 7% more beneficial, and of Spergon 4% more beneficial to germination than the 1 ounce per bushel dosage. However, the 2 ounce per bushel dosage of Semesan Jr. reduced the germination 21% below that given by the 1 ounce dosage.

Two factors, prolonged low temperature and soil-borne disease organisms, were assumed to cause loss of germination in the cold test. It was demonstrated that soil-borne diseases caused all or practically all of the loss of germination observed. Inbred line 07 germinated only 1% in the cold test without seed treatment. This result was shown to be caused by disease organisms.

A simple laboratory test was conducted to determine the effect of low temperature on germination. Seed of inbred 07 was germinated under the same controlled low temperature conditions as used in the cold test. However, the seed was germinated free from soil-borne disease organisms on a sterile, 2% agar substrate in petri dishes. Germination was 100% under these conditions.

Treated and untreated seed produced on the single cross Hy2 x 38-11 averaged 6.5% more resistant to soil-borne disease organisms than the reciprocally crossed seed produced on the inbred lines. The inbred seed averaged 7% more susceptible to soil-borne disease organisms than the hybrid seed produced with Hy2 x 38-11 using the inbreds as seed parents. Seed of inbred lines I.205, L317, and Tr were found to be 85% resistant, and hybrids and their reciprocals involving these lines with Hy2 x 38-11 were 70% resistant to soil-borne disease organisms. Inbred lines 38-11, 07, and WF9 were 29% resistant, and hybrids and their reciprocals involving these lines were 60% resistant to soil-borne disease organisms.

Field trials of treated seed stored 2 months at 15% moisture. Semesan Jr. applied at 2 ounces per bushel damaged the seed and reduced the yield of grain of the resulting crop an average of 35% below that of the untreated seed. In these trials the effects of Arasan and Spergon were not consistent.

Field trial of treated seed stored 19 months at 15% moisture. Arasan and Semesan Jr. damaged the seed. Stands produced from Arasan treated seed were 24% less, and from Semesan Jr. treated seed were 35% less than stands produced by untreated seed.

Spergon at 1 ounce per bushel was beneficial as stands were increased 11% over stands produced by the untreated seed.

Field trials with slurry-treated seed. Slurry treatment with Semesan Jr. was injurious to the extent that stands resulting from treated seed were 18% below stands produced by the untreated seed.

Sound, disease-free, slurry-treated seed was planted as late as June 15, 1948. Benefits in stand for Arasan and Spergon were 4% and 3% respectively, over stands of the untreated check. With uniform stands, benefits in yield were 7% and 4% respectively, over the yields of the untreated check. The increased yield of grain resulting from treated seed was observed as an increased number of seeds produced per plant. Seed size, plant height, ear height, and number of ears per plant were not affected.

Only inbred line 07 when used as a seed parent of hybrids in this trial was significantly benefited by seed treatment.

Discussion and Conclusions

In the cold test Arasan was found to be the most beneficial seed treatment, Spergon next, and Semesan Jr. the least. These treatments were given index ratings by multiplying the ratio of the germination of the treated seed to that of the untreated seed by 100. The index ratings for Arasan, Spergon, and Semesan Jr. are 337, 287, and 273, respectively.

The different kinds of seed, varying from susceptible to resistant germinated in the cold test, was benefited proportionately by each seed treatment. However, seed susceptible to soil-borne disease organisms was benefited more by seed treatment than resistant seed. This differential benefit can be expressed by the regression coefficient 0.79. Hence, for an increase in germination of 1% of the untreated seed there is a corresponding increase of 0.79% germination of treated seed. The correlation coefficient for the germination of the treated seed with that of the untreated seed is 0.89.

In the field trials planted with slurry-treated seed, hybrids considered susceptible to soil-borne disease organisms were benefited by seed treatment. Hybrids considered partially resistant to these organisms were not benefited by seed treatment. It was concluded from these field trials that sound, disease-free seed that is susceptible to soil-borne disease organisms is benefited more by seed treatment than sound, disease-free seed that is somewhat resistant to these organisms.

This investigation brings out the important point that exposure of seed to low temperature is not the cause of poor germination. Sus-

ceptibility to soil-borne diseases is the major cause of poor field stands. Seed treatment protects susceptible seed from the attack of these organisms and consequently field stands are raised. A susceptible line, when treated, becomes therefore, more like a resistant line.

But resistant lines are also benefited by seed treatment. This is because they are only partially resistant. They are not immune to disease. Immune lines would not need to be treated to get a full stand.

Seed corn, though sound and disease-free, may be benefited by seed treatment if it is susceptible to the attack of soil-borne organisms. Information gained so far indicates that no corn is immune. Partially resistant corn can be benefited by seed treatment. Therefore, the almost universal practice of treating all seed corn is justified by:

(1) inexpensiveness of treatment,

(2) disinfection of surface contamination and some minor internal infection,

(3) presence of soil-borne disease organisms, and

(4) susceptibility and lack of immunity of seed corn to soil-borne diseases.

By protecting seed and seedlings from the attack of soil-borne disease organisms 2 results are obtained; namely, (1) better stands, and (2) more vigorous seedlings. Hence, higher yields are expected than if seed is not treated, and the increase in yield probably much more than makes up for the cost of materials and the labor of applying them.

VITA

The author was born at Arcola, Douglas County, Illinois, on July 28, 1920. He attended the Arcola public schools, and was graduated from the Arcola Township High School in May, 1938. Having been awarded a four year, competitive agricultural scholarship to the University of Illinois, he entered the University in September 1938. In June 1942, he was graduated from that institution with the degree of Bachelor of Science in Agriculture.

Immediately after graduation he entered the Army of the United States of America and served as an officer until being separated from the service in December, 1945.

In March, 1946, he returned to the University of Illinois and began his graduate study. At the beginning of his third graduate year, February 1948, he was awarded a fellowship in Agronomy.

He is a member of the American Society of Agronomy, Sigma Xi, and Gamma Sigma Delta.

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